ENERGY ENGINEERING
(CHE2105)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Indian coals are mainly
(a) Anthracite (b) Bituminous
(c) Sub-bituminous (d) All of the above

(ii) If porosity of the coke increases then _____ decreases
(a) Reactivity (b) Surface area
(c) Mechanical strength (d) Softness

(iii) Pick out the correct statement
(a) Pour point is higher than cloud point
(b) Pour point is lower than cloud point
(c) Pour point is same as cloud point
(d) Pour point may be higher or lower than cloud point.

(iv) Smoke point is expressed in
(a) ^0C (b) K (c) mm (d) cm

(v) Anti-knocking characteristics of gasoline is indicated by
(a) Diesel index (b) Cetane number
(c) Octane number (d) Flash point

(vi) Blue gas is another name of
(a) Blast furnace gas (b) Producer gas
(c) Coke oven gas (d) Water gas

(vii) The production of methane and CO_2 is carried out through
(a) Hydrolysis (b) Fermentation
(c) Methanogenesis (d) Acetogenesis

(viii) Flat plate collector absorbs
(a) Only beam radiation (b) Only diffuse radiation
(c) Both (a) and (b) (d) None of these

(ix) Concentration ratio of flat plate solar collector is
(a) 0 (b) 1
(c) 2 (d) None of these

(x) Heavy water is used as a _____ in a nuclear reactor
(a) Fuel (b) Moderator
(c) Radiation Shield (d) None of these

Fill in the blanks with the correct word

(xi) _____ coal burn with a yellow smokey flame.

(xii) Metallurgical coke is _____ coke.

(xiii) The cetane number of a diesel fuel may be improved by the addition of _____.

(xiv) n- heptane is assigned _____ octane number.

(xv) _____ type of solar collector has the maximum concentrating capacity.

Group - B

2. The following data were reported during coal analysis in boiler of Raniganj coal field. As, C = 62.4%, H = 4.2%, O = 4.5%, N = 0.4%, S = 0.2%, moisture = 14.4%, ash = 13.9%. Assume average molecular weight of ash is 56. Determine the molecular formula of coal and heating value on as received basis and dry basis using the following equation,
HHV in MJ/Kg = 0.3516 C + 1.16225 H – 0.1109 O + 0.0628 N + 0.10465 S
LHV in MJ/Kg = HHV (in MJ/Kg) – 0.0244 (M - 9H). *[(CO2)(Analyse/HOCQ)]*
12

3. (a) Briefly discuss the recovery of waste heat during the production of coke from coke oven process with a help of a neat flow sheet. *[(CO2)(Analyse/HOCQ)]*
(b) What is by – product of slot type coke oven? How the recovery of by – product from coke oven gas is being performed? *[(CO2)(Apply/IOCQ)]*
6 + 6 = 12

Group - C

4. (a) Discuss sweetening process for petroleum stock. *[(CO3)(Remember/LOCQ)]*
(b) Discuss the advantage of catalytic cracking over thermal cracking. *[(CO4)(Analyze/IOCQ)]*
(c) Mention the type of catalyst used. Also compare fixed bed process to fluid bed process of catalytic cracking. *[(CO4)(Apply/IOCQ)]*
4 + 2 + (3 + 3) = 12

5. (a) Mention the purpose of 'Visbreaking'. Write down the salient features of the operation. *[(CO3)(Remember/LOCQ)]*
(b) Define the following:
(i) Fire point (ii) smoke point (iii) pour point. *[(CO3)(Remember/LOCQ)]*
6 + 6 = 12

Group - D

6. (a) How can 'producer gas' be made? Mention the advantages of using producer gas as fuel. *[(CO5)(Analyse/HOCQ)]*
   (b) Mentioning the raw materials, write down the principle reactions. *[(CO5)(Remember/LOCQ)]*
   (c) Define cold gas efficiency. *[(CO5)(Apply/IOCQ)]*

4 + 6 + 2 = 12

7. (a) Classify fuel gases based on mode of occurrence and method of production. *[(CO5)(Analyse/HOCQ)]*
   (b) Define rich gas and lean gas. Give examples. *[(CO5)(Remember/LOCQ)]*
   (c) Define the following:
   (i) Wobbe index
   (ii) Carbon efficiency. *[(CO5)(Apply/IOCQ)]*

4 + 4 + 4 = 12

Group - E

8. (a) Define efficiency of closed cycle of OTEC system. *[(CO6)(Remember/LOCQ)]*
   (b) What is colour rendering index (CRI)? *[(CO6)(Remember/LOCQ)]*
   (c) Explain the working principle of Molten Carbonate Fuel Cell. *[(CO6)(Apply/IOCQ)]*

3 + 3 + 6 = 12

9. Attempt any three of the followings:
   (i) Short note on solar ponds
   (ii) Operating principle of proton exchange membrane fuel cell
   (iii) Laws of thermal radiation
   (iv) Short note on pyranometer. *[(CO6)(Remember/LOCQ)]*

(3 × 4) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	45.83	27.08	27.08